

**REMARKS**

**I. STATUS OF CLAIMS**

Claims 1, 4, 5, and 11-22 are pending. Claims 2, 3, and 6-10 have been canceled without prejudice or disclaimer and new claims 17-22 have been added. Claim 1 has been amended to recite that the polishing liquid contains cerium (IV) nitrate. Support for this amendment is found in the specification, for example, at page 5, lines 17-18. New claims 7-22 have been added to further clarify the present invention. Support for these amendments are found throughout the specification, for example, at pages 5, line 16 through page 7, line 10. As the current amendments find full support in the specification and claims as originally filed, no new matter has been added.

**II. RESTRICTION REQUIREMENT**

The Office has required a restriction under 35 U.S.C. § 121 between the following groups:

- I. Claims 1-12, drawn to a polishing method,
- II. Claims 13-16 drawn to a polishing liquid.

The Office alleges that Groups I and II are related as product and process of use, but are distinct from each other because the product, a polishing liquid, may be used in a materially different process than polishing a substrate containing Ru or a Ru

compound such as polishing metals that are not made of ruthenium and its compounds (see Office Action dated July 9, 2001, page 2).

Applicants elect, with traverse, the claims of Group I drawn to a polishing method on the merits. Prior to the current amendments Group I included claims 1-12. Applicants bring to the Examiner's attention that after the present amendments, the claims drawn to a polishing method include claims: 1, 4, 5, 11, 12, and 17-22.

The restriction requirement is improper because there would be no "serious burden" on the Examiner if all the claims were to be examined together. This serious burden is one criterion for a restriction requirement (M.P.E.P. § 803). Claims 13-16 incorporate limitations relating to a polishing liquid, as do method claims 1, 4, 5, 11, 12, and 17-22. Therefore, the scope of the Examiner's search of the art to evaluate the patentability of method claims 1, 4, 5, 11, 12, and 17-22, as well as claims 13-16 should not place a serious burden on the Examiner that supports a requirement for restriction. According, Applicants respectfully request that the Examiner withdraw this restriction requirement.

### III. REJECTIONS UNDER 35 U.S.C. § 102(b)

The Examiner has rejected claims 1 and 6 under 35 U.S.C. § 102(e) as obvious over Westmoreland et al., U.S. Patent 6,143,192, "*Westmoreland*."

The Examiner alleges that *Westmoreland* may be used as a component of a slurry used in a CMP process and that the ceric ammonium nitrate solution is the same as the claimed polishing liquid containing tetravalent cerium ions and diammonium

cerium (IV) nitrate. Applicants respectfully traverse this rejection on the grounds that *Westmoreland* does not teach every claim limitation of claim 1.

For a 35 U.S.C. §102 rejection to be proper, a single prior art reference must contain every element of the claimed invention, including all claim limitations. See *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q. 2D (BNA) 1913, 1920 (Fed. Cir.1989), cert. denied, 493 U.S. 853, 107 L. Ed. 2d (1989).

As amended, the present claim 1 recites, *inter alia*, a polishing method comprising polishing of a substrate containing Ru or a Ru compound in a surface region with a polishing liquid containing cerium (IV) nitrate.

*Westmoreland* does not teach or suggest use of a polishing liquid containing cerium (IV) nitrate. *Westmoreland* discloses a method for removing at least a portion of a structure including Ru metal and/or ruthenium dioxide by contacting the structure with a material including ceric ammonium nitrate (*Westmoreland*, Abstract). *Westmoreland* is completely silent regarding use of cerium (IV) nitrate in a polishing media. In fact, none of the exemplified processes disclosed in *Westmoreland* teach or suggest polishing of a substrate containing Ru or a Ru compound in a surface region with a polishing liquid containing cerium (IV) nitrate as is presently claimed. Thus, *Westmoreland* does not teach or suggest every element of the presently claimed invention and therefore does not anticipate the present invention. Accordingly, Applicants respectfully request that the rejection of claim 1 under 35 U.S.C. §102(e) be withdrawn.

Regarding claim 6, Applicants respectfully submit that the Examiner's rejection has been rendered moot in view of the cancellation of claim 6. As such, Applicants respectfully request that the rejection of claim 6 under 35 U.S.C. §102(e) be withdrawn.

**IV. REJECTION UNDER 35 U.S.C. § 103(a)**

The Examiner has rejected claims 2-5 and 7-12 under 35 U.S.C. § 103(a) as obvious over *Westmoreland* as applied to claims 1 and 6 (Office Action dated July 9, 2001, page 4). Regarding the recitation of  $\text{SrRuO}_3$  in claims 5 and 12, the Examiner alleges that it would have been obvious to one of ordinary skill to modify the method of *Westmoreland* by replacing a Ru compound (Ruthenium metal, ruthenium dioxide or a combination of ruthenium metal and ruthenium dioxide) with  $\text{SrRuO}_3$  because they are equivalent (*Id.*, page 4). In addition, the Examiner alleges that it would have been obvious to adjust the time in which a prepared polishing liquid is supplied to a substrate surface by optimizing the same through experimentation for the purpose of obtaining the best etched layer (*Id.*, page 5).

Applicants submit that the Examiner's basis of rejection for claims 2, 3, and 7-10, has been rendered moot in light of the cancellation of claim 2, 3, and 7-10. Applicants respectfully traverse the claim 5 rejection on the basis that *Westmoreland* does not teach or suggest every limitation of claim 5.

In determining obviousness, 35 U.S.C. § 103 expressly requires consideration of the claimed invention "as a whole." For a prima facie case of obviousness, the Examiner must show some motivation for modifying the teachings of the references,

and a reasonable expectation of success in doing so. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification. *In re Gordon*, 733 F.2d 900, 902, 221 U.S.P.Q. 1125, 1127 (Fed. Cir. 1984).

Claims 4 and 5 of the present invention recite, *inter alia*, a polishing method using a polishing liquid containing cerium (IV) nitrate. As discussed above, *Westmoreland* does not mention use of cerium (IV) nitrate as a possible ingredient in its etching solution. *Westmoreland* discloses use of only one compound, ceric ammonium nitrate, as a component of its etching solution. None of solutions exemplified in *Westmoreland* disclose use of cerium (IV) nitrate. There is nothing in the disclosure of *Westmoreland* to motivate one of ordinary skill in the art to substitute cerium (IV) nitrate for ceric ammonium nitrate. As such, claims 4 and 5 are not obvious over the teachings of *Westmoreland*. Claims 11 and 12 are discussed below.

Applicants respectfully submit that new claims 17-22 are not obvious over *Westmoreland*. Claim 17 recites a polishing method comprising, *inter alia*: preparing a first polishing liquid containing tetravalent cerium ions in a first concentration; adding a solvent to said first polishing liquid to form a second polishing liquid, polishing a surface of a substrate containing Ru or a Ru compound in a surface region with the second polishing liquid, wherein the addition of the solvent is carried out upon or immediately before the polishing of the substrate. Thus, claim 17 is directed to a polishing method using a diluted first polishing liquid. By contrast, *Westmoreland* discloses a removing method and is directed to a planarization by etching rather than by polishing. This is

evidenced by *Westmoreland*'s examples which utilize high concentration solutions.

For instance, the comparative solutions disclosed in Example 1 of *Westmoreland* include the following etching solutions: aqua regia at 100°C, piranha solution at about 100°C, HCl/peroxide solution at about 85 °C, concentrated phosphoric acid solution at about 150 °C, an ammonium hydroxide/peroxide solution at about 100 °C, pure 100% bromine at room temperature, and 30% by weight potassium hydroxide solution at about 85 °C (*Westmoreland*, col. 7, lines 5 - 48). Examples 2 and 3 disclose utilization of room temperature baths of CR-14 Chrome Etchant (*Id.*, col. 7, line 60 to col. 8, line 1, and col. 8, lines 53-54, respectively). These solutions are clearly etchants.

In Example 2, the concentration of ceric ammonium nitrate used in the CR-14 Chrome Etchant is 30%. This is exceedingly high. A technique utilizing such a high concentration of ceric ammonium nitrate etches rather than polishes. If the entire surface of a substrate is polished with a composition containing such a high concentration of ceric ammonium nitrate, the midsection of the substrate will become recessed and dishing will occur. Dishing is detrimental in polishing applications.

The present invention utilizes low concentrations of tetravalent cerium ions to polish a substrate without producing dishing effects. This is done by diluting the first polishing liquid with a solvent to obtain a low concentration of tetravalent cerium ions. *Westmoreland* does not teach or suggest dilution of its etching solutions. In addition, *Westmoreland* does not mention or recognize the phenomenon of dishing, let alone a polishing method to reduce this undesirable phenomenon.

Also, the presently claimed invention recites that the addition of the solvent is carried out upon or immediately before the polishing of the substrate. This is done to



ensure that the polishing liquid's oxidizing power is at its optimum strength. Applicants have shown the decay of oxidizing power in polishing liquids with low tetravalent cerium ion concentrations. Fig. 1 depicts Ru polishing rate as a function of time. The Ru polishing rate decreases as time progresses. At about the 48 hour mark, the Ru polishing rate is approximately one half of a newly prepared polishing solution (See Fig. 1).

*Westmoreland* is completely silent with regards to the time sensitivity of the oxidizing power and the subsequent instability of its etching solution. There is nothing in the *Westmoreland* disclosure to motivate one of ordinary skill to modify *Westmoreland's* etching process by first preparing a first polishing liquid containing tetravalent cerium ions in a first concentration; and then adding a solvent to said first polishing liquid to form a second polishing liquid, polishing a surface of a substrate containing Ru or a Ru compound in a surface region with the second polishing liquid, wherein the addition of the solvent is carried out upon or immediately before the polishing of the substrate. As such, taken "as a whole", the prior art reference does not disclose or suggest the polishing method of claim 17. Since not every claim limitation of claim 17 is taught or suggested by *Westmoreland*, claim 17 is not obvious and is patentable.

Additionally, claim 17 is an independent claim. The Federal Circuit has held that if an independent claim is non-obvious under 35 U.S.C. §103, then any claim depending therefrom is non-obvious as well. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q. 2d 1496 (Fed. Cir. 1988). Claims 11, 12, and 18-21 are dependent on non-obvious independent claim 17. As such, claims 11, 12, and 18-21 are non-obvious and patentable.

Claim 22 recites, *inter alia*, a polishing method utilizing a first polishing liquid comprising cerium (IV) nitrate. As previously discussed, *Westmoreland* does not teach or suggest use of cerium (IV) nitrate. Rather, *Westmoreland* discloses only use of solutions containing high concentrations of ceric ammonium nitrate as etchants. There is simply no motivation in *Westmoreland* to modify its teachings to arrive at the presently claimed polishing method. As such claim 22 is also non-obvious in view of the teachings of *Westmoreland*.

In light of the foregoing, Applicants respectfully request the withdrawal of the rejections under 35 U.S.C. §103(a).

#### CONCLUSION

In view of the foregoing amendments and remarks, Applicants respectfully request the reconsideration and reexamination of this application and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

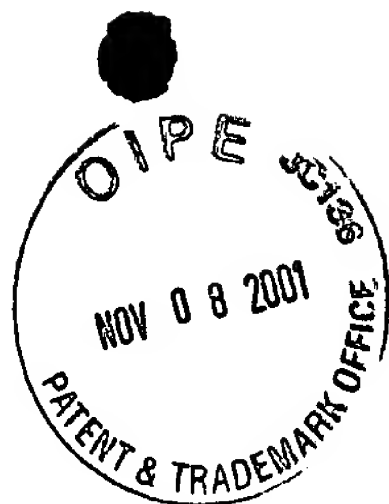
FINNEGAN, HENDERSON, FARABOW,  
GARRETT & DUNNER, L.L.P.

Dated: November 8, 2001

By: 

Richard V. Burgujian  
Reg. No. 31,744





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**APPENDIX TO AMENDMENT OF NOVEMBER 8, 2001**

**Version with Markings to Show Changes Made**

Amendments to the Claims

1. (Amended) A polishing method[,] comprising: [the steps of] polishing a surface of a substrate containing Ru or a Ru compound in a surface region with a polishing liquid containing [tetravalent cerium ions] cerium (IV) nitrate.

11. (Amended) A polishing method according to claim [6] 17, wherein said second polishing liquid does not contain abrasive grains.

12. (Amended) A polishing method according to claim [6] 17, wherein said Ru compound is  $\text{SrRuO}_3$ .

LAW OFFICES

FINNEGAN, HENDERSON,  
FARABOW, GARRETT,  
& DUNNER, L.L.P.  
1300 I STREET, N. W.  
WASHINGTON, DC 20005  
202-408-4000